INTEGRATING FORMAL METHODS INTO SOFTWARE DEPENDABILITY ANALYSIS

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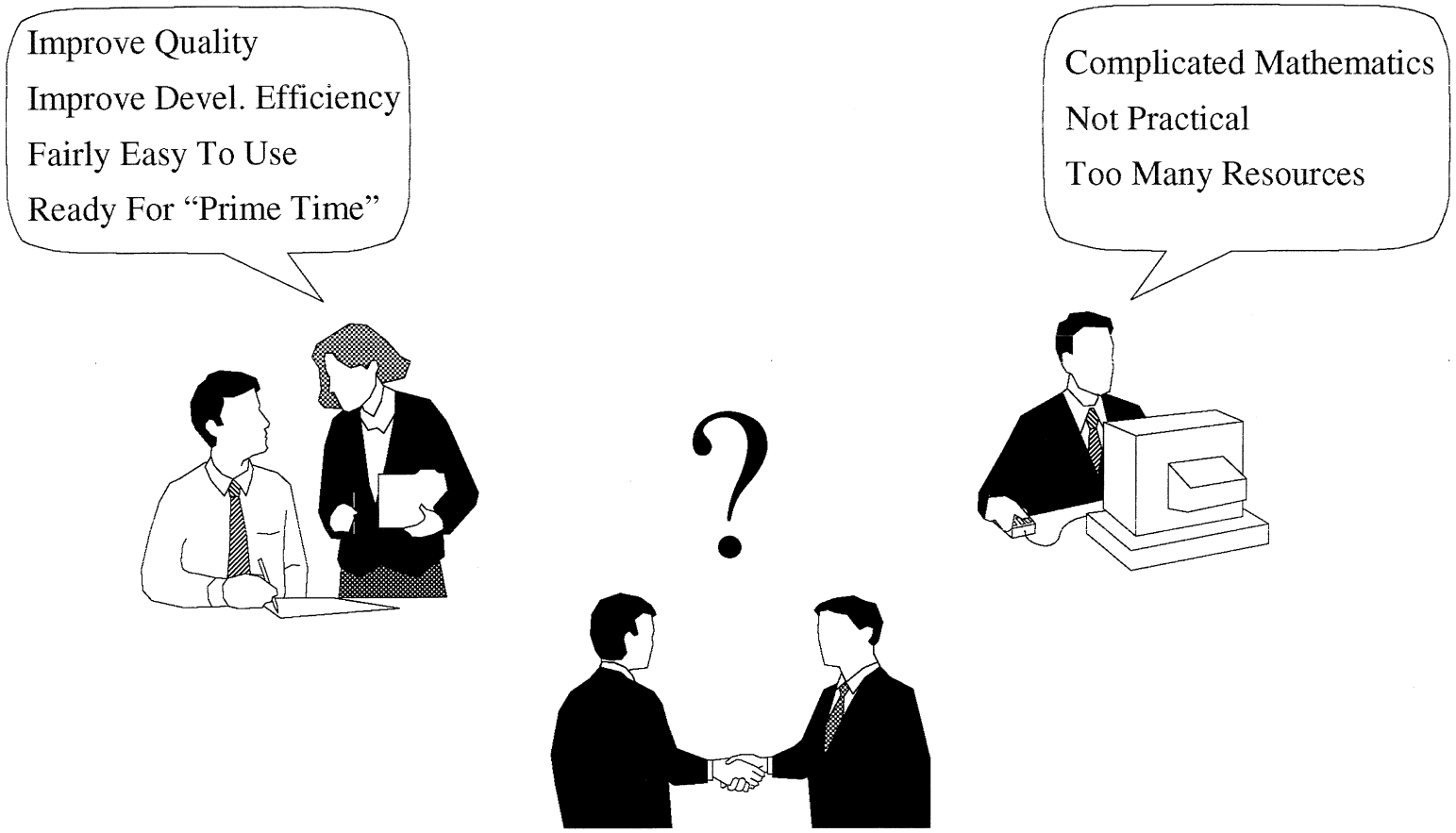
THE USE OF FORMAL METHODS



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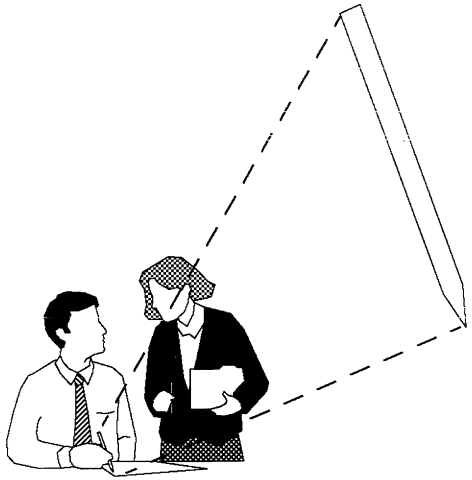
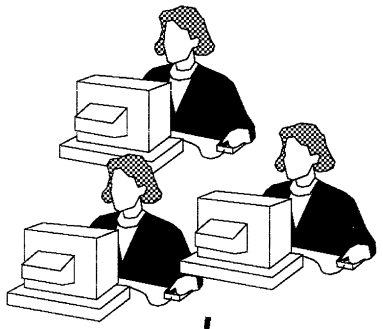
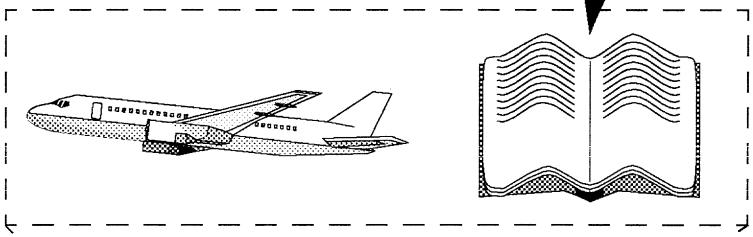
HYPOTHESES

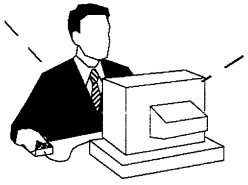


Formal
Techniques

Software
Development
Process







System
Dependability
Assessment

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QUESTION

- There Are Many Excellent Formal Techniques, Including:
  - Formal Specification
  - Specification Analysis
  - Refinement/Reification
  - Correctness Proofs
  - Property Proofs
- But, Comprehensive Formal Analysis Of Large Systems Is Impractical, So:

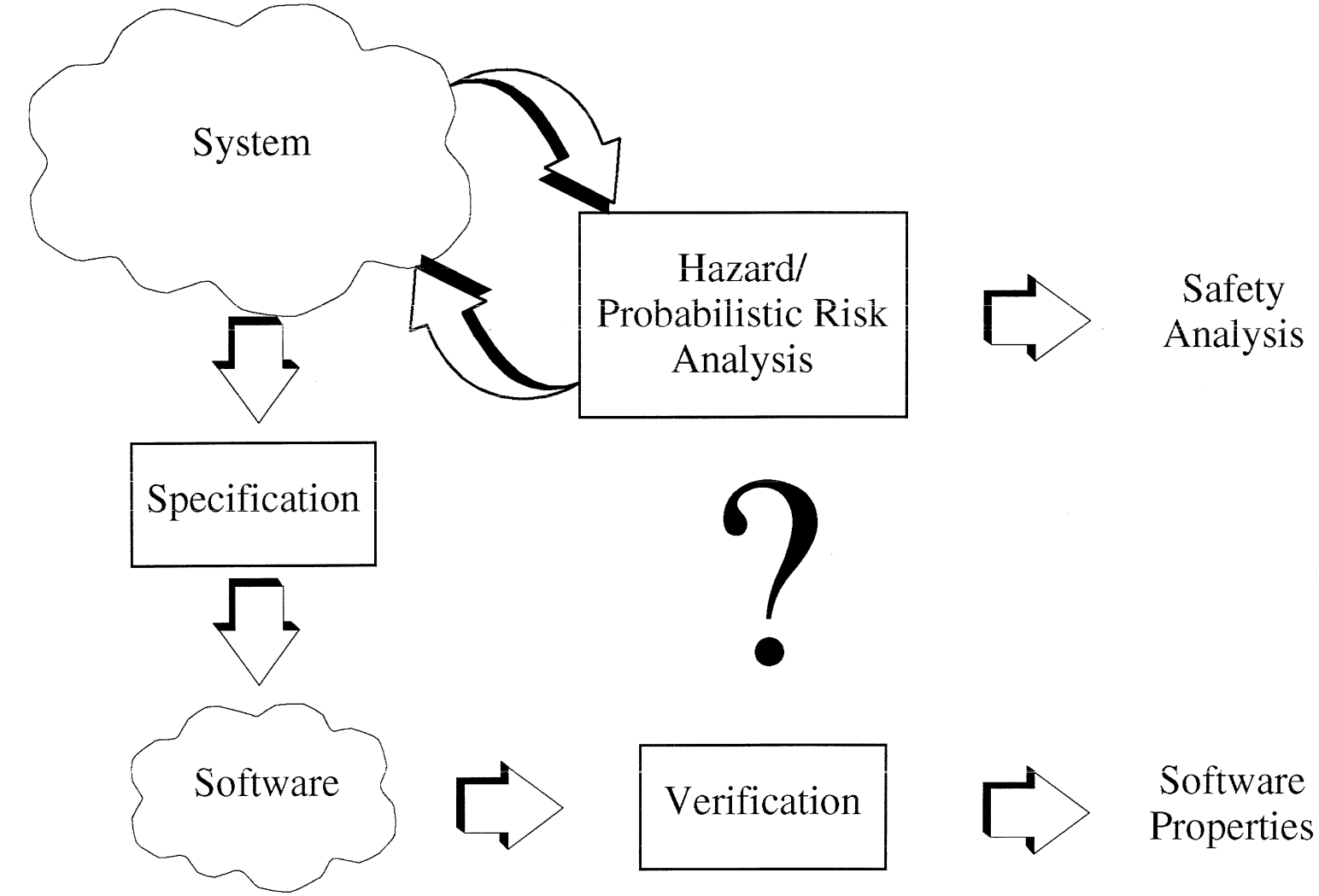
To which parts of a system should formal techniques be applied?

- Need A Means Of Determining Where They Can Be Applied Most Effectively

APPLICATION AND EVALUATION

- Formal Specification Has Been Used Extensively, For Example:
  - Statecharts — By Airbus, Guidant, Boeing
  - Z — By IBM, Praxis
  - SCR/Core — By NRL, Lockheed
  - PVS — By JPL, Rockwell Collins
- Various Evaluations Performed, For Example:
  - Craigen, Gerhart, Ralston (NIST)
  - Ardis et al. (Lucent)
- Previous Work Did Not Address Breadth Of Use:
  - Evaluation Criteria Tended To Be Technical, Performance Oriented

WHY BE FORMAL IN SW DEVELOPMENT?



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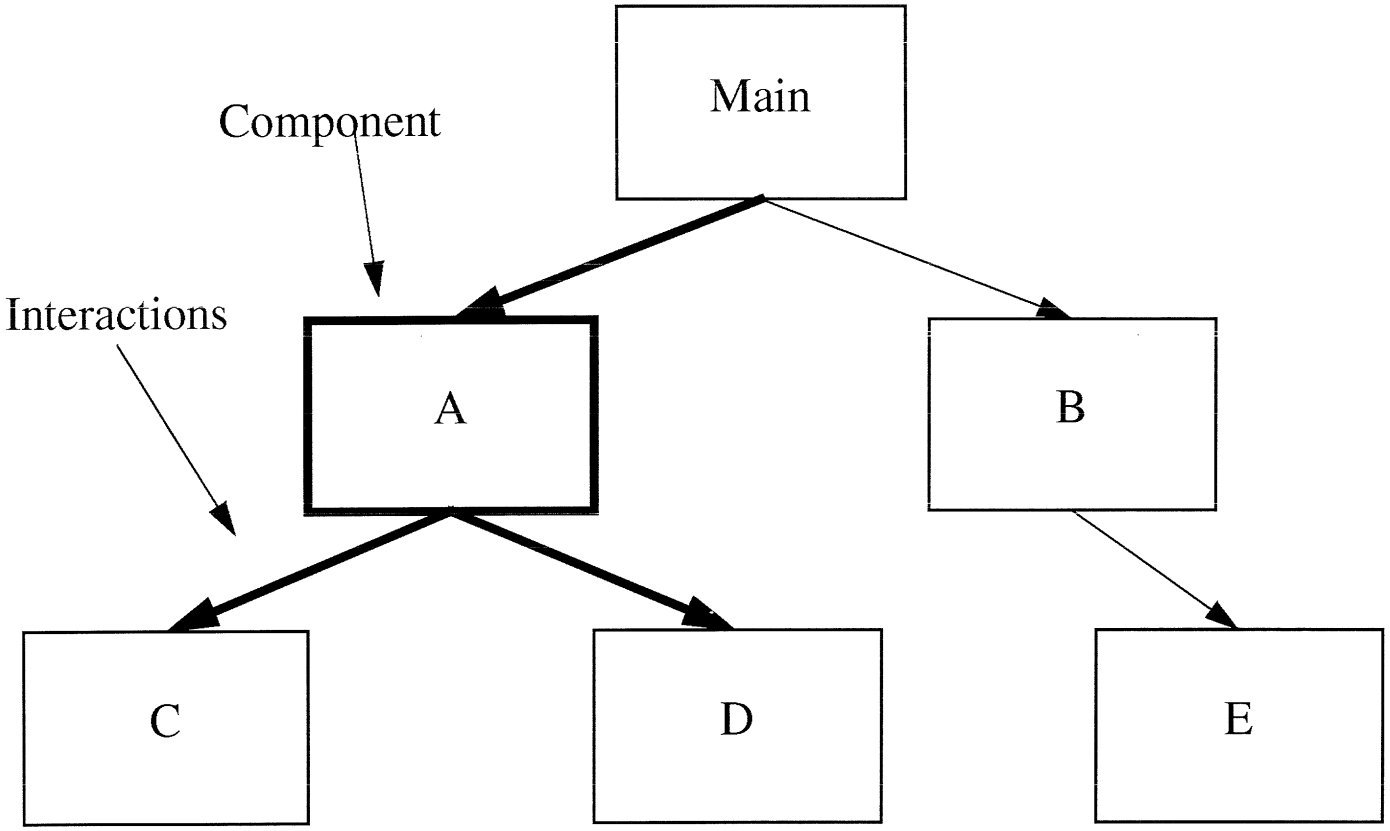
SW IN SYSTEM DEPENDABILITY ASSESSMENT

- Software Provides Lots Of Functions:
  - Are They All Critical?
  - Do They All Fail The Same Way?
- Typical Practices—Assume Only One Software Failure Event, And:
  - Try To Measure Probability Of Failure By Life Testing
  - Or Set Probability Of Failure To One
  - Or Maybe Zero
  - Or Maybe Model Using A "Reasonable" Distribution
- Software System Life Testing:
  - Its Generally Infeasible (Butler And Finelli)
  - Its Worse Than That (Ammann, Brilliant, And Knight)

SOFTWARE STRUCTURE



- Model Software Using Its Component Structure
- Analogy With Hardware Analysis

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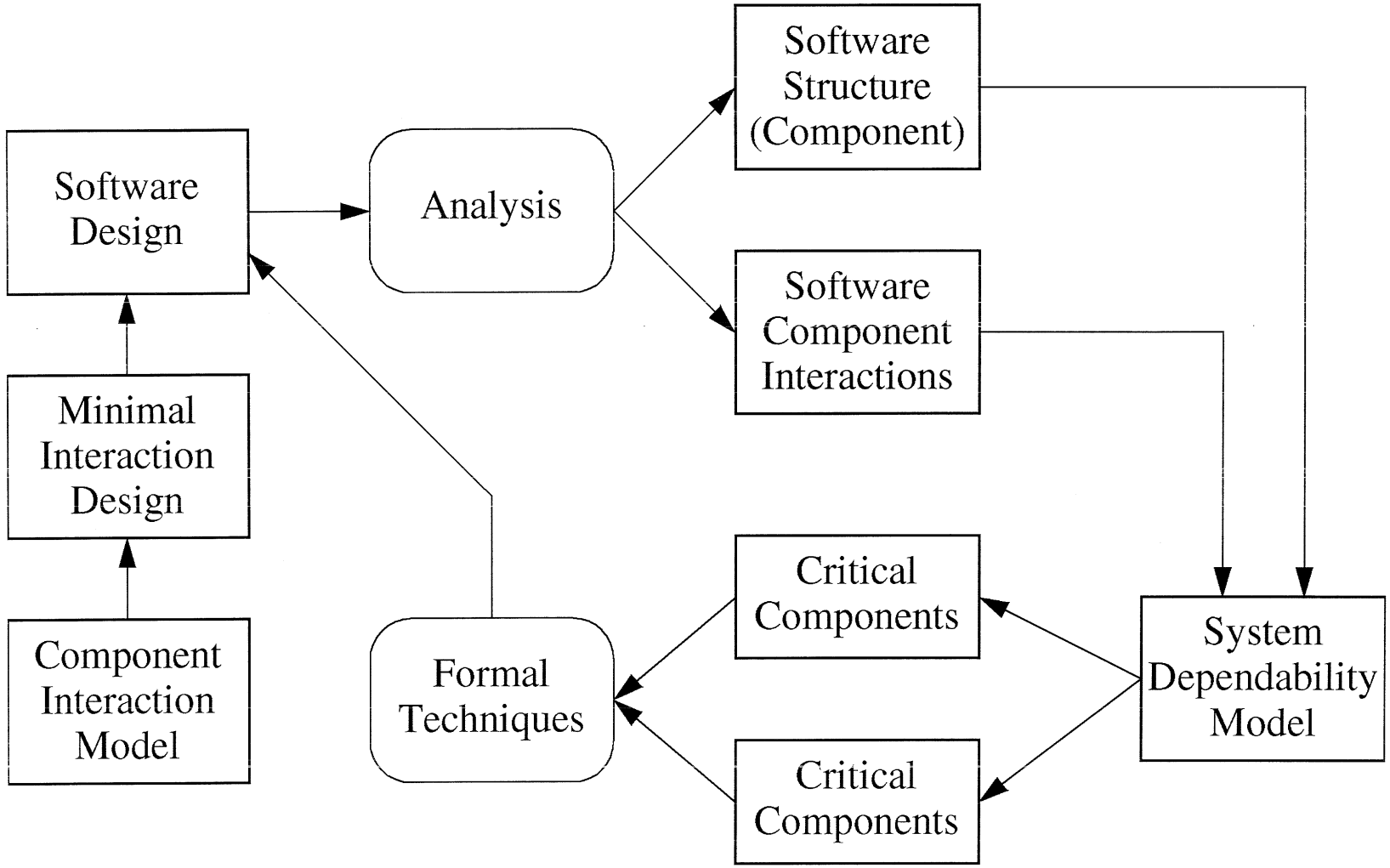
COMPONENT MODEL OF SW DEPENDABILITY



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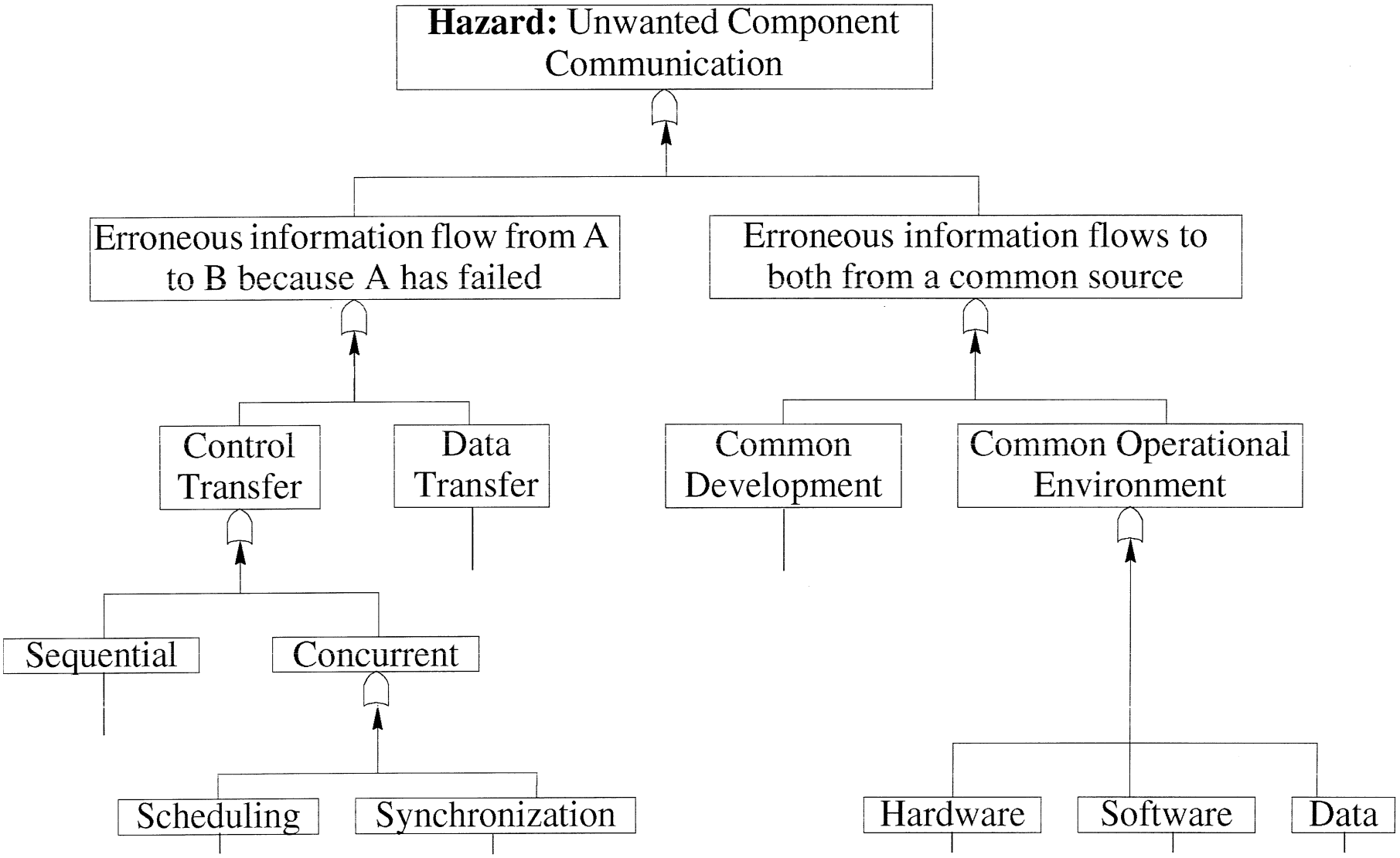
COMPONENT INTERACTION MODEL



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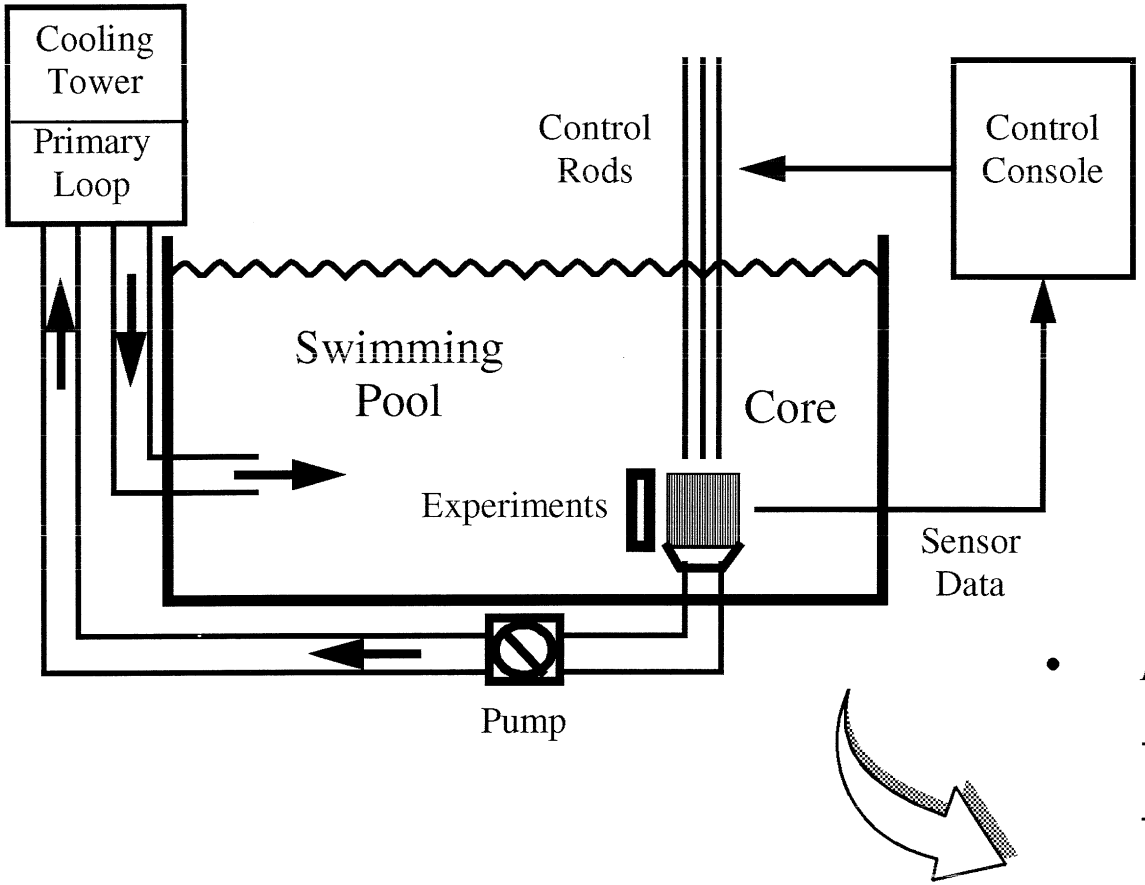
UNIVERSITY OF VIRGINIA REACTOR SYSTEM



- *Lots* Of Software:
  - Operating Systems
  - Network
  - Window System
  - User Interface

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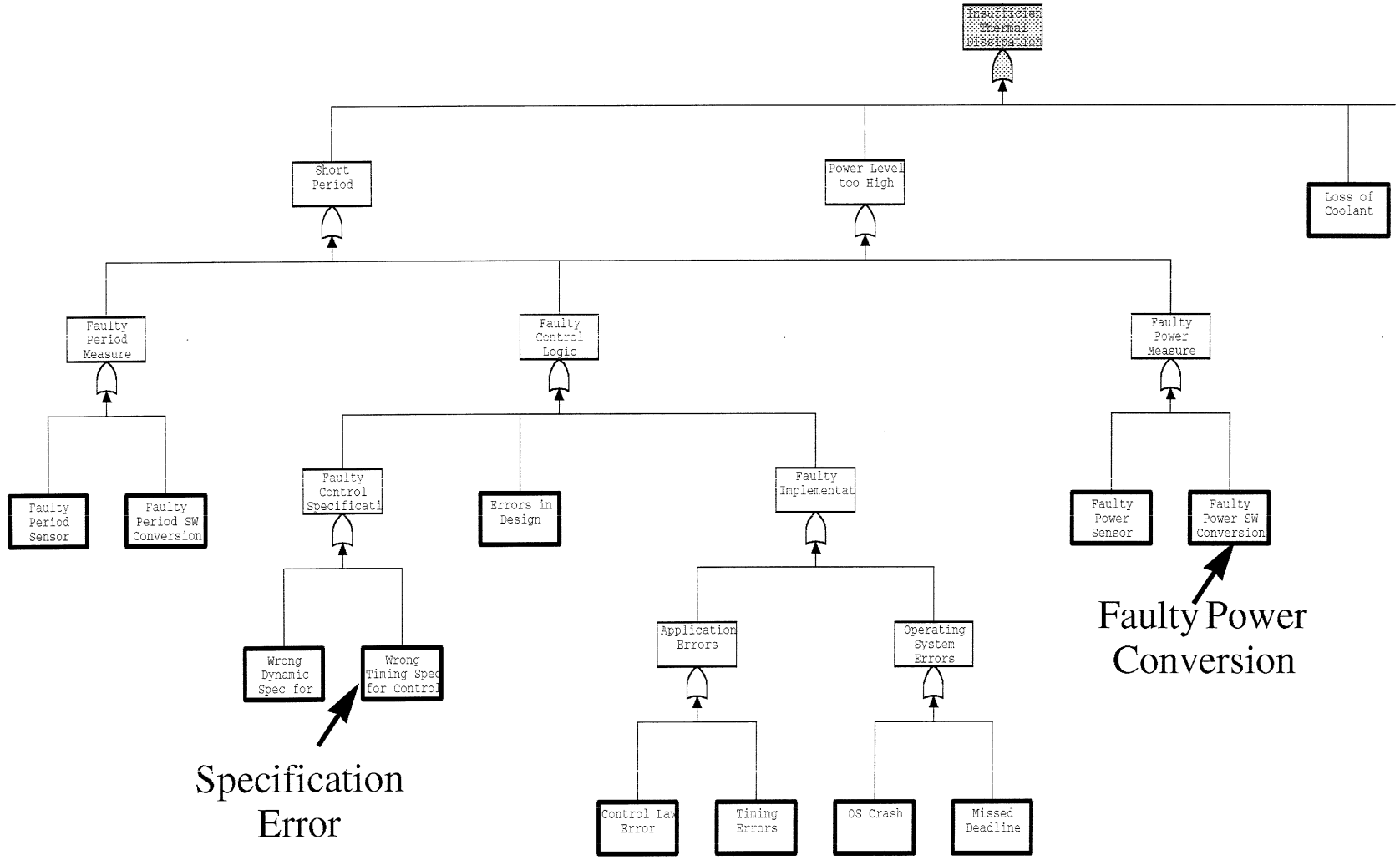
SOFTWARE FAULTS



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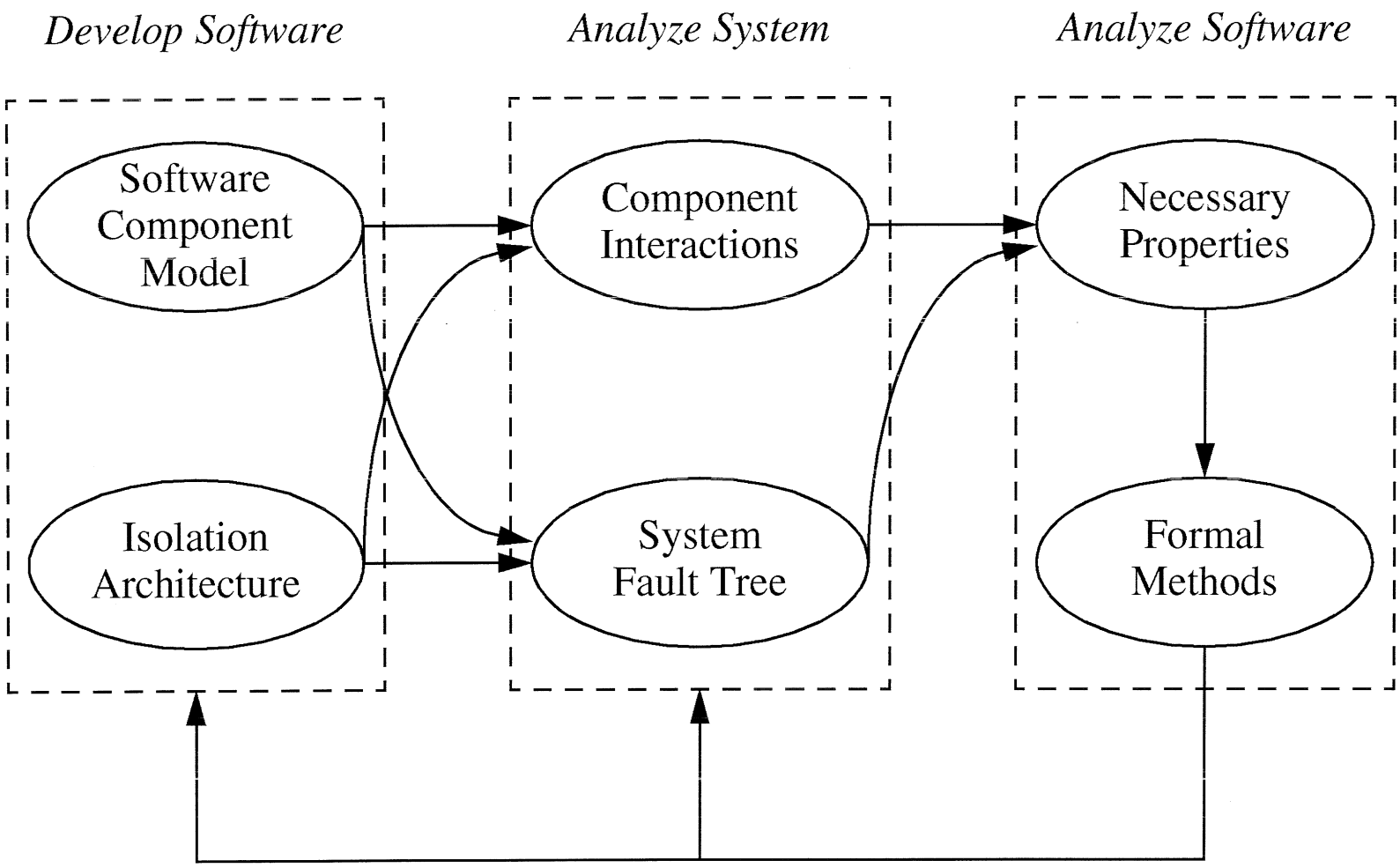
INTEGRATED ROLE OF FORMAL TECHNIQUES



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CONCLUSIONS

- Software Not Well-Integrated With System Dependability Assessment
- No Precise Role For Formal Techniques In Development
- Formal Techniques Don't Contribute Directly To System Dependability Assessment
- Component Model Of Software Dependability Developed
- Based On:
  - Component Software Design
  - Component Interaction Model
  - Integration Of Component Analysis In System Fault Tree
  - Enhancement Of Software Design Based On Fault-Tree Analysis